

THE RODENTS OF LAGOS AND THEIR ECTO-PARASITES WITH REFERENCE TO PLAGUE

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Bubonic Plague first made its appearance in Lagos late in July, 1924. A vigorous 'rat campaign' was at once instituted. Under the supervision of the Medical Officer of Health, several Sanitary Inspectors, with a number of trappers, were detailed for the destruction and collection of rats.

The animals were labelled and taken to a collecting station (equipped by the Medical Research Institute), where their species was determined and their ecto-parasites collected, after which they were dissected and examined.

Four areas were operated, namely Lagos, Iddo, Ebute-Metta and Apapa. All of these are within the Municipal Boundary, the two former being separated from each other and from the two latter by an expanse of water; several miles of swampy land lie between Ebute-Metta and Apapa. Early in 1925, cases of Plague occurred at Agege, a village some twelve miles inland by rail from Ebute-Metta, and rat-trapping was conducted there also.

Cases of Human Plague occurred only in Lagos and Agege. The epi-zoötic was found in the rats only in Lagos, Iddo and Agege. Ebute-Metta and Apapa remained free from the infection.

The methods of rat destruction were trapping and various poisoning devices. The latter were discontinued after a short trial.

The traps used were mainly of the 'break-back' type, and although many attempts were made to lure the animals into cages, these met with but little success. Consequently very few live

rodents were obtained. The rodents dealt with were the black rat, *Rattus rattus*, the brown rat, *R. norvegicus*, the mouse, *Mus musculus*, the shrew, *Crocidura manni*, the striped field-rat, *Lemniscomys fasciatus*, and the pouched rat, *Cricetomys gambianus*.

Plague occurred in the first four named but not in the last two; very few specimens of the last two, however, were collected.

Amongst the black rats there were several more or less marked variations in colouring and, to a less extent, in shape. Some individuals came near *R. r. frugivorus*. In the Agege rats particularly, there was evidence of breeding between different species.

Mus musculus greatly predominated in the total catch. They had become so numerous by June, 1925, that it was found impossible to dissect them all. For the first month or two of the campaign, however, in each of the areas, the black rat was caught in greater numbers than any of the other species of rodents. The brown rat was third in numerical importance and fourth place was taken by the shrew.

From the scarcity of *Lemniscomys fasciatus* and *Cricetomys gambianus* in the daily bag, it would appear that these rodents are not usual frequenters of the houses and stores.

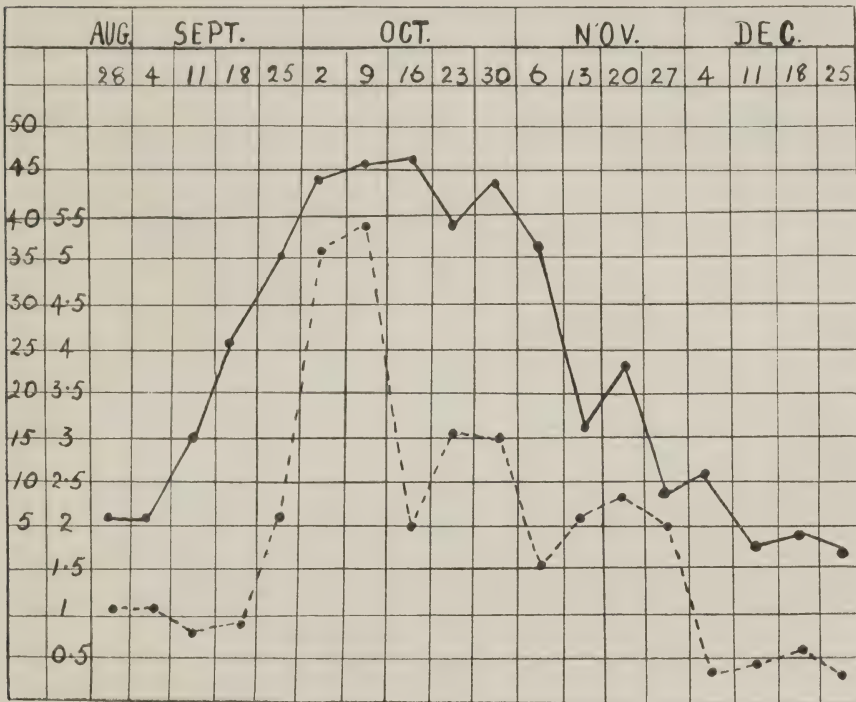
For the detection of plague-stricken animals, two smears were taken from the cut surface of the spleen. The small staff available and the large number of specimens dealt with daily, rendered it impossible to make a complete examination of each individual. As a rule, however, the acute congestion seen on section and the excess of fluid in the serous cavities were an obvious indication of the presence of Plague. Carbol-thionin blue was the principal stain used for the spleen-smears, as it appeared to demonstrate the bi-polarity of the bacillus most clearly. It was observed that, in positive smears, the violet tint of the stain is altered to a slatey-blue. If all the slate-blue smears were picked out they were found to contain practically all the positives, although some showed organisms other than *B. pestis*. In cases of doubt, the duplicate spleen smear was treated with Gram's stain.

As regards plague-infected rodents, it is possible that their number is somewhat under-estimated, for two reasons given above, namely, because many mice were not dissected and because only spleen smears were examined microscopically.

Chart I shows the relationship of human and rat plague during the latter half of 1924. During 1925 this was not so plainly shown by

graphic methods. The Chart indicates that, from 4 September until 11 December, a rise in the percentage of infected rats preceded, by one week, a rise in the number of human cases. Both before and after this period the number of human cases was small.

CHART I.



Dotted lines show percentage of infected rats.

Uninterrupted lines show total human cases of plague per week.

28th August—25th December, 1924.

Table I gives the details of the rodents collected in the area of Lagos. August and September have been grouped together because, although trapping was begun in August, the system was not in complete working order until September. The total monthly catches show a steady increase rising from 2,207 in August-September, 1924, to 16,129 in December, 1925. The growing catches were due to greater efficiency as time passed, and are also to be explained by the response from the general public to a definite rate of payment for rats brought to the collecting station. The mouse, except during the first three months, predominated over the black rat and, in the final figures, the proportion is three to one. The black rat out-

numbered the brown rat by nearly eight to one. The shrew was somewhat less common than the brown rat. No specimens of the pouched rat or of the striped rat were obtained.

TABLE I.
The Rodents of Lagos.

Month	<i>R. ratt.</i>	<i>R. norv.</i>	<i>M. musc.</i>	<i>C. manni.</i>	Total	Infected
1924.						
August-September ...	1,200	488	519	...	2,207	17r, 10n, 6m, 33
October ...	1,358	125	778	217	2,478	56r, 5n, 15m, 3s, 79
November ...	1,250	65	1,216	314	2,845	42r, 4n, 6m, 3s, 55
December ...	960	54	2,290	295	3,599	13r, 2m, 15
1925.						
January ...	1,042	55	3,816	220	5,133	7r, 5m, 12
February ...	974	96	4,547	243	5,860	1r, 2m, 3
March ...	999	203	4,942	181	6,325	1m, 1
April ...	1,041	95	4,206	158	5,500	0
May ...	1,387	186	6,199	177	7,949	1m, 1
June ...	2,837	320	9,986	261	13,404	9r, 9
July ...	3,405	456	10,956	252	15,069	8r, 8
August... ..	3,224	473	10,385	203	14,285	5r, 1n, 6
September ...	2,822	535	10,342	131	13,830	35r, 5n, 40
October ...	3,558	454	10,957	174	15,143	65r, 8n, 73
November ...	3,298	461	10,897	120	14,776	52r, 6n, 58
December ...	2,708	442	12,861	118	16,129	65r, 6n, 71

NOTE.—In the last column *r* signifies *R. rattus*.
n " *R. norvegicus*.
m " *M. musculus*.
s " *C. manni*.

TOTALS.— <i>Rattus rattus</i> ...	32,063,	Infected	375
<i>Rattus norvegicus</i> ...	4,508,	"	45
<i>Mus musculus</i> ...	104,897,	"	38
<i>Crocidura manni</i> ...	3,064,	"	6
	144,532,	"	464

Of the four species of rodents, there were fluctuations from month to month except in the case of the mice.

As regards plague infection, the black and the brown rat were affected in nearly equal proportion, that is, about 1 per cent.

It is curious to note that the increase in the number of infected rats during the last four months of 1925 co-incident with no great increase in the number of human cases.

TABLE II.
The Rodents from Iddo.

Month	<i>R. ratt.</i>	<i>R. norv.</i>	<i>M. musc.</i>	<i>C. manni.</i>	<i>L. fasc.</i>	<i>C. gamb.</i>	Total	Infected
1924.								
October ...	124	4	55	11	...	...	194	5r, 1s, 6
November	222	13	90	68	...	...	393	12r, 1n, 1s, 14
December	94	2	56	38	...	2	192	5r, 5
1925.								
January ...	115	2	35	76	1	...	229	...
February	99	...	33	35	1	...	168	...
March ...	131	1	43	20	2	...	197	...
April ...	120	...	121	10	...	...	251	...
May ...	111	1	210	5	...	...	327	...
June ...	106	...	179	...	...	...	285	...
July ...	82	...	174	1	...	...	257	...
August ...	231	...	120	7	...	...	358	...
September	80	...	143	2	...	...	225	...
October ...	115	1	110	2	...	...	228	...
November	110	...	94	12	...	...	216	...
December	134	2	162	6	...	...	304	...

NOTE.—In the last column *r* signifies *R. rattus*.
n " *R. norvegicus*.
s " *C. manni*.

TOTALS.— <i>Rattus rattus</i> ...	1,874,	Infected 22
<i>Rattus norvegicus</i> ...	26	" 1
<i>Mus musculus</i> ...	1,625	" ...
<i>Crocidura manni</i> ...	293	" 2
<i>Lemniscomys fasciatus</i> ...	4	" ...
<i>Cricetomys gambianus</i> ...	2	" ...
	3,824	" 25

Table II gives the figures of the rodents captured in Iddo. This island is a much smaller one than Lagos, and it yielded a comparatively small catch. Trapping was begun in October, 1924, and the results differed greatly from those seen in Table I. The black

rat, in nine months of the period under review, out-numbered the mouse and the total count for fifteen months shows 1,874 black rats to 1,625 mice. The shrew ranked next to the mouse in numbers and it appeared in the proportion of ten to one of the brown rat. Only twenty-six specimens of the brown rat, four of the striped rat and two of the pouched rat were obtained.

Infected animals were observed in a higher proportion than that found in Lagos during the last three months of 1924, but during 1925 there were no signs of infection.

TABLE III.
The Rodents from Ebute-Metta.

Month	<i>R. Ratt.</i>	<i>R. norv.</i>	<i>M. musc.</i>	<i>C. manni.</i>	<i>L. fasc.</i>	<i>C. gamb.</i>	Total.
1924.							
November ...	115	4	251	3	...	...	373
December ...	298	10	574	24	...	...	906
1925.							
January ...	350	2	714	57	2	...	1,125
February ...	290	...	915	53	2	...	1,260
March ...	286	...	1,001	42	1	...	1,330
April ...	294	...	1,195	31	1	1	1,522
May ...	343	...	1,337	22	...	1	1,703
June ...	420	...	967	22	...	...	1,409
July ...	452	...	1,164	17	...	...	1,633
August ...	386	1	1,139	23	...	...	1,549
September ...	382	2	1,036	14	...	...	1,434
October ...	306	...	997	4	...	...	1,307
November ...	188	5	791	4	...	...	988
December ...	129	10	615	6	...	...	760

TOTALS.—*Rattus rattus* 4,239
Rattus norvegicus 34
Mus musculus 12,696
Crocidura manni 322
Lemniscomys fasciatus 6
Cricetomys gambianus 2

17,299

Table III deals with the rodents collected at Ebute-Metta. This district ranks next to, but is considerably smaller than Lagos in extent. The proportion of the mouse to the black rat is the same as in Lagos, i.e., three to one. The other figures, however, correspond more closely to those found in Iddo. The shrew is more common than the brown rat in the ratio of ten of the former to one of the latter. Only thirty-six brown rats were obtained and, in addition, there were six striped and two pouched rats:

No infected animals were found.

Tables IV and V concern the rodents from Apapa and from Agege. Both districts are small and the period during which trapping was in progress was short. Both tables show a preponderance of the black rat over the mouse, this being more marked in Agege than in Apapa.

No specimens of the brown rat were obtained in Agege.

TABLE IV.
The Rodents from Agege.

Month	<i>R. ratt.</i>	<i>M. musc.</i>	<i>C. manni.</i>	<i>L. fasc.</i>	Total	Infected
1925.						
March	34	11	1	...	46	5r, 1m, 6
April	76	32	1	...	109	1r, 1
May	52	27	2	...	81	...
June	141	68	...	3	212	...
July	182	83	2	4	271	...
August	79	14	4	1	98	...
September	16	17	1	...	34	...
October... ..	25	11	...	...	36	...

NOTE.—In the last column *r* signifies *R. rattus*.
m ,, *M. musculus*.

TOTALS.—*Rattus rattus* ... 605, Infected 6
Mus musculus ... 263, ,, 1
Crocidura manni ... 11, ,, ...
Lemniscomys fasciatus ... 8, ,, ...
 887 ,, 7

TABLE V.

The Rodents from Apapa.

Month	<i>R. ratt.</i>	<i>R. norv.</i>	<i>M. musc.</i>	<i>C. manni.</i>	Total
August 1925.	49	4	...	12	65
September	109	7	21	4	141
October... ..	64	5	106	17	192
November	40	3	88	4	135
December	41	6	65	7	119

TOTALS.— <i>Rattus rattus</i>	303
<i>Rattus norvegicus</i>	25
<i>Mus musculus</i>	280
<i>Crocidura manni</i>	44
	652

ECTO-PARASITES

Four species of ecto-parasites were obtained from four species of rodents (*R. rattus*, *R. norvegicus*, *M. musculus* and *C. manni*). These were *Xenopsylla cheopis*, *X. brasiliensis*, *Ctenocephalus canis* and *Laelaps echidninus*.

As previously noted, very few live rats were received, so that the collection now to be described came mainly from dead animals.

The rodents, as a routine measure, were brought to the laboratory in pails containing a liquid disinfectant. In order to obtain the ecto-parasites, each rat was well shaken in the fluid which was thereafter passed through a sieve of a mesh sufficiently small to prevent the escape of the insects. The retained matter in the sieve was then washed into a white enamelled basin from which the fleas and *Laelaps* could be readily picked out with forceps. This procedure, being somewhat laborious, could not be carried out in Lagos during 1925. The figures which follow, therefore, refer for the most part to Ebute-Metta, Iddo and Agege.

Only twenty-six live rats were obtained. During the last three months of 1924, fifteen *R. rattus* were killed with chloroform and searched. Only six yielded fleas and these numbered sixty-eight, as follows: 15, 14, 14, 12, 9, 4; an average of 11 per rat infested.

In March, 1925, two *R. rattus* were received in a single cage, from which four male *X. cheopis* were obtained. Of three live *R. rattus* caught in September, one had no fleas, one had four fleas and a *Laelaps*, and the third had seventeen fleas. These were identified as *X. cheopis*, 10 ♂♂, 3 ♀♀, *X. brasiliensis*, 4 ♂♂, 4 ♀♀, and *L. echidninus*, 1. In October there were received three *R. norvegicus* in one cage, two *R. rattus* in one cage, and a single *R. rattus* in a cage. The first three animals carried *X. brasiliensis*, 5 ♂♂, 1 ♀, the next two, *X. cheopis*, 2 ♀♀, *L. echidninus*, 3, and the single rat, *X. cheopis*, 1 ♀, 1 ♂.

These findings are included in the following figures which deal with the much larger number of insects recovered from dead rodents.

Tables VI, VII and VIII show the distribution of the ectoparasites in the areas of Lagos, Iddo, Ebute-Metta and Agege. Iddo is included in Table VI for 1924, and in Table VII for 1925.

TABLE VI.
Ecto-Parasites from Lagos and Iddo.

Month	<i>X. cheopis</i>		<i>X. brasiliensis</i>		<i>C. canis</i>	<i>L. echidninus</i>
	♂	♀	♂	♀	♂	
September 1924.	8	5	12	5	1	4
October	58	41	37	31	...	5
November... ..	156	129	63	45	...	4
December	69	54	66	39	...	5
January 1925.	4	6	8	5	...	14
March	4	...	...	...	...	...
October	1	3	...	...	...	3
	300	238	186	125	1	35

TOTALS.—*Xenopsylla cheopis* 538
Xenopsylla brasiliensis 311
Citnocephalus canis 1
Laelaps echidninus 35

885

TABLE VII. Exto-Parasites from Ebute-Metta and Iddo.

Month	<i>X. cbeopis</i>		<i>X. brasiliensis</i>		<i>C. canis</i>		<i>L. ecbidninus</i>
	♂	♀	♂	♀	♂	♀	
December 1924.	13	4	5	5	8	3	...
January 1925.	16	12	3	1	...	...	10
February	11	13	3	12	...	...	16
March	26	17	8	7	...	...	3
April	17	15	7	7	...	...	3
May	11	21	7	12	...	...	19
June	23	18	12	6	...	...	5
July	26	9	10	3	...	...	31
August	1	1	3	1	...	...	5
September	25	7	8	13	...	...	4
October	5	3	13	1	...	...	8
	174	120	79	68	8	3	104

TOTALS.—*Xenopsylla cbeopis* 294
Xenopsylla brasiliensis 147
Ctenocephalus canis 11
Laelaps ecbidninus 104

556

TABLE VIII. Ecto-Parasites from Agege.

Month	<i>X. cbeopis</i>		<i>X. brasiliensis</i>	<i>L. ecbidninus</i>
	♂	♀		
March, 1925	2	2	...	3
April	7	2	1	10
May ... ..	...	...	...	...
June... ..	...	...	...	2
July ... ..	...	2	...	1
	9	6	1	16

TOTALS.—*Xenopsylla cbeopis* 15
Xenopsylla brasiliensis 1
Laelaps ecbidninus 16

32

It has not been possible to collect data regarding variations in the number of fleas or in the preponderance of one species over another at different seasons. Many, if not most of the insects, must have left their host between the time of its death in the trap and its collection by the trapper. Nevertheless, as over 1,000 fleas have been examined, it is probably correct to assume that *X. cheopis* is more common than *X. brasiliensis*, the actual numbers identified being 847 of the former, to 459 of the latter. In all the three species found, the male predominates over the female.

Some interesting experiments were done early in 1925, using guinea-pigs as flea-traps. The results of these experiments did not confirm the above finding, that *X. cheopis* is more common than *X. brasiliensis*.

On 8th January, two guinea-pigs were allowed to run loose in a room from which a Plague corpse had been removed a few hours earlier. This room had not been disinfected. After two minutes the guinea-pigs were re-captured, put into a white cloth sack and taken back to the laboratory where they were lightly chloroformed. Twenty-one fleas were recovered from them, *X. brasiliensis*, 19, and *X. cheopis*, 2.

On 17th January the experiment was repeated but on this occasion the room had been disinfected twenty-four hours previously. The guinea-pigs got in between a double row of palm mid-ribs which formed one of the walls of the house, and twenty minutes elapsed before they were re-captured. They were found to have collected thirty-three fleas, *X. brasiliensis*, 28, and *X. cheopis*, 5.

On the same day, two guinea-pigs were allowed to run loose in a non-infected house for two minutes. These collected no fleas.

On 19th January the experiment was repeated in a room which had been disinfected forty-eight hours previously. Two fleas were recovered, both *X. cheopis*.

Disinfection in the above instances had been by means of burning sulphur in the approved manner.

In the final experiment, on 12th February, the room had been disinfected twenty-four hours previously by means of spraying with a mixture of kerosene and cyllin. No fleas were found on the two guinea-pigs which had had two minutes' freedom in this room.

SUMMARY

One hundred and sixty-seven thousand, one hundred and ninety-four rodents are dealt with, along with one thousand, five hundred and twenty-nine ecto-parasites.

The area investigated is Lagos and its environs.

The rodents found are *Mus musculus*, *Rattus rattus*, *Rattus norvegicus*, *Crocidura manni*, *Lemniscomys fasciatus* and *Cricetomys gambianus*. The ecto-parasites are *Xenopsylla cheopis*, *Xenopsylla brasiliensis*, *Laelaps echidninus* and *Ctenocephalus canis*.

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